WEDNESDAY, MARCH 29TH, 1893.

ANNUAL GENERAL MEETING.

The President, Professor Haswell, M.A., D.Sc., in the Chair.

Messrs. L. Stephenson, R. Murdoch, A. H. S. Lucas, and Captain Hynes were introduced as visitors.

The minutes of the last Annual Meeting were read and confirmed.

PRESIDENT'S ADDRESS.

During the fourteen months which have elapsed since the last Annual General Meeting the Society may be said to have had a season of steady work and substantial progress. The ordinary meetings have been well attended, and I think I may say that the papers contributed have on the average attained a very high level of excellence. In respect of bulk, notwithstanding a considerable drain resulting from the simultaneous publication of the Macleay Memorial Volume, the "Proceedings" of the year will be up to the average: three parts have already been issued and the fourth is in preparation.

During the year ten new members have been elected: eleven have been lost by death or retirement, leaving a total of about 137 ordinary members on the roll of the Society.

It is my painful duty to have to record the loss which the Society has sustained during the past year by the deaths of six ordinary members—the Rev. R. Collie, F.L.S., the Rev. William Woolls, Ph.D., F.L.S., the Hon. Alex. Dodds, M.L.C., Layman M. Harrison, J. N. Macintosh and W. Neill.

The Rev. R. Collie, a native of Aberdeenshire, came to New South Wales in 1876, and was elected minister of the Free Church of Scotland at Newtown, in which charge he continued until his death last year. He was an enthusiastic student of our native flora, to our knowledge of which he made various contributions. He was for five years a member of this Society and took a considerable interest in its meetings. He bequeathed to it his extensive herbarium of dried plants, and over a hundred books on various branches of natural history, many of them valuable and useful additions to the Society's library.

The Rev. Dr. William Woolls, long a member and latterly a Vice-President, was well known for his extensive and accurate knowledge of Australian Botany. Born in 1814 at Winchester, he came out to this colony as a lad of 17, and shortly afterwards obtained a mastership in the King's School, Parramatta. Afterwards he came to Sydney and engaged in journalistic work and private tuition till he was offered a classical mastership at the Sydney College. Later he returned to Parramatta, where he opened a private school. In 1873, at the age of 59, he took holy orders in the Church of England, and held for ten years the incumbency and rural deanery of Richmond. For many years he gave much of his leisure to the study of botany, and he rendered valuable assistance to Bentham and Mueller in collecting specimens to be made use of in the elaborating of their "*Flora Australiensis.*" He obtained the degree of Ph.D. from the University of Goettingen for his thesis on the Plants of Parramatta. He was the author of two volumes of essays on scientific and other subjects, and of several botanical papers, some of which have been published in the "Proceedings" of this Society.

Of the loss sustained by biological science in the death of the veteran comparative anatomist, Sir Richard Owen (whom this Society honoured itself by electing an honorary member many years ago), it is scarcely needful for me to speak at length on the present occasion. A worthy estimate of Owen's scientific work and its bearing on the progress of science in Australia would, even were I competent to undertake it, require an Address or a series of Addresses to itself. Let me, however, recall to you the fact that in the rich record of Owen's half-century of scientific work not a few of the most notable achievements have been epochmaking discoveries in the natural history of Australia and New Zealand. The Australian mammals and the extinct birds of New Zealand are the themes of a large proportion of the long list of his contributions to natural science, and the recorder of the history of discovery in Australian zoology must always refer to the name of Owen as one of the greatest contributors to our knowledge. With Sydney, Owen was specially connected by his life-long friendship and correspondence with our veteran naturalist—Dr. George Bennett.

Macleay Memorial Volume.

At the last Annual Meeting I had the honour to bring before you the proposal that a Macleay Memorial Volume, containing a series of original contributions to science, should be published in honour of Sir William Macleay's memory and in recognition of his eminent services to the cause of science. The proposal met with your approval, and steps were at once taken to have the scheme carried into effect. A Publication Committee, consisting of Hon. Dr. Norton, Mr. Etheridge and myself, with Mr. Fletcher, was appointed by the Council and has held frequent meetings during the year. The appeals which were made to the members of the Society and to the general public for contributions towards the cost of the Memorial have resulted altogether in the sum of about £240 being obtained, which, though somewhat disappointing, when we consider the extent of the liberality which we desire to commemorate, has been sufficient to justify us in proceeding with the work. This has now approached very near completion, under the able editorship of Mr. Fletcher, and the time has arrived when it has become necessary to come to a definite understanding with regard to this Volume and the relations which it is to bear to the Society.

The contents of the Volume, of which a copy comprising all except the Preface and Introduction and two papers, which are not yet in type, is placed on the table, will be as follows:—

Frontispiece. Portrait of Sir William Macleay, reproduced by Freeman from a photograph by the platinotype process.

I. Preface, setting forth briefly the design and objects of the Memorial, with a list of the names of the Subscribers.

II. Biographical Memoir of Sir William Macleay, written by Mr. Fletcher.

III. Contributions to a knowledge of *Ceratodus*. Part I. The Blood-vessels. By Professor W. Baldwin Spencer, 34 pp.

IV. On the Pliocene Mollusca of New Zealand. By Professor F. W. Hutton, F.R.S., 57 pp.

V. A monograph of the Temnocephaleæ. By Professor W. A. Haswell, 60 pp.

VI. On an apparently new type of the Platyhelminthes (Trematoda ?). By Professor W. A. Haswell, 5 pp.

VII. On the muscular anatomy of *Palinurus Edwardsii*, Hutton. By Professor T. Jeffery Parker, F.R.S., and Josephine Gordon Rich, 18 pp.

VIII. On the anatomy of the muzzle of *Ornithorhynchus*. By Professor J. T. Wilson and Dr. C. J. Martin, 10 pp.

IX. On rod-like tactile organs in the muzzle of *Ornithorhynchus*. By Professor J. T. Wilson and Dr. C. J. Martin, 11 pp.

X. On *Parmacochlea Fischeri*, Smith. By C. J. Hedley, 3 pp.

XI. On the geographical relations of the floras of Norfolk and Lord Howe Islands. By Professor Ralph Tate, 16 pp.

XII. On an undescribed *Acacia* from New South Wales. By Baron Sir Ferdinand von Mueller, F.R.S., 4 pp.

XIII. Description of a new *Hakea* from Eastern New South Wales. By Baron Sir Ferdinand von Mueller, F.R.S., and J. H. Maiden, F.L.S., 2 pp.

XIV. A description of some of the implements and weapons of the Alligator Tribe, Port Essington, N.A. By R. Etheridge, junr., about 20 pp.

The work will be illustrated by thirty-five plates, which have, in the majority of cases, been lithographed by R. Wendel, and printed by Messrs. Troedel, and are, as I consider, very satisfactorily executed.

New Rules.

In August of last year a sub-committee, consisting of the Hon. Dr. Norton, Mr. Fletcher, and myself, was appointed in order to draw up a new set of Rules for the Society. A draft of these was submitted to the Council and passed with a few modifications. At a general meeting called for the purpose on December 21st these proposed new Rules were discussed, some amendments introduced, and the Rules as amended were finally adopted at a general meeting held on the 29th December.

One of the chief new provisions is the institution of a recess in the monthly meetings of the Society during the months of December, January, and February. This is a reform which was greatly needed; and, though the number of monthly meetings will thus be reduced, I have little doubt that the Society will actually gain as regards the total value and interest of the work done.

It has also been decided to do away with the office of Hon. Secretary—an office which, with the present Permanent Secretary, meant nothing, and involved no work. The number of Members of Council not office-bearers has been raised to twelve, and a quorum of not less than five has been fixed for the minimum for the transaction of business.

It has been decided also to raise the entrance-fee for all ordinary members to two guineas, and to make the subscription for all after 1893 one guinea. A few new Rules relating to minor matters, and a few modifications of the formerly existing Rules, have been introduced; but none of these are of sufficient importance to call for remark at present. Copies of these new Rules with an amended list of members will shortly be in your hands.

Résumé of Recent Work.

Since it has been customary for the President of the Royal Society of New South Wales to give annually a general account of the scientific work done within the Colony during the year, and since this will shortly be ably done by my friend Professor Warren, I decided to make the subject of this, my second Presidential Address to this Society, an account of any important additions to biological knowledge that had been made in other countries in the course of the last twelve months or so. But before I had made much progress with this, I found that any attempt at a comprehensive review of the history of Biology during the period would be entirely out of the question: it would demand, among other things, a more complete command of the literature of the subject than is attainable in Australia, it would require more time than I had left for it, and it would take one far beyond all reasonable limits for an address of this kind. I have, therefore, thought it better to confine myself to two subjects, viz., "Recent views on the structure of protoplasm and the significance of the various parts of the cell"; and "Recent work on the Marsupials and Monotremes," the former as being one of the questions of the day with biologists in general, the latter as being of special interest to those of us who have the fortune to be resident in Australia.

Recent views on the structure of protoplasm and the significance of the various parts of the cell.

Stimulated in part, without doubt, by the publications of the great German theorist Weismann and his disciples and critics or opponents, research and discussion on cell-structure and the various phases of cell-division has been fairly active during the last year or two. Attention has been attracted to the importance of determining more definitely the meaning and functions of the various parts of the cell; and some definite progress has undoubtedly been made of late in our knowledge of the relative importance in connection with nutrition, movement, regeneration of lost parts and reproduction, of the different parts of the animal and plant cell. The position of predominance not long ago accorded to the nucleus by almost all biologists has, in the view of many, become less assured. Formerly the nucleus was regarded as the physiologically essential part of the cell, the cytoplasm or protoplasm of the body of the cell serving mainly as a storehouse of nutriment and a field in which the activities of the nucleus could be exercised, not capable of initiating any important changes, and taking only a passive part in cell-multiplication and reproduction. Certain changes which take place in the cell-protoplasm during these processes were usually supposed to be brought about more or less mechanically as a result of the changes that take place in the nucleus itself. The appearance of the bodies termed "attraction spheres" and "centrosomes" first discovered by E. van Beneden,* with the nuclear spindle, was regarded as a phenomenon quite subordinate in importance to the division of the chromatin substance of the nucleus itself. But since it has been shown that the centrosomes and attraction-spheres become prominent before the chromosomes actually undergo division, and particularly since it has been found that the attraction-spheres and central corpuscles are capable of determination in cells which do not multiply mitotically,† it has seemed probable to the majority of the investigators of cell-structure that in these bodies we may have to recognise independent centres of activity within the cell apart from the nucleus. Moreover the behaviour of these bodies during mitotic cell-division appears to indicate in no uncertain manner that they have a part of importance to play in the process. The fibrillæ of the spindle appear to go out from the centrosomes to become connected with the chromosomes, and it seems to be by a movement of contraction of these fibrils that the two sets of divided chromosomes are drawn apart towards the poles of the spindle. Flemming in a recent address‡ expresses himself in the following terms with reference to the importance of these bodies:—"Wir haben die Aussicht dass an die Kenntniss dieser

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* "Recherches sur la maturation de l'œuf, la fécondation et la division cellulaire" (1883); and Van Beneden et Neyt, "Nouvelles recherches sur la fécondation et la division mitosique." Mém. Acad. Roy. Belg. 1887.

† First by Flemming ("Attraktionsphären und Centralkörpes in Gewebszellen und Wanderzellen," Anat. Anz. VI. 1891); afterwards confirmed by Heidenhain ("Ueber die Centralkörperchen und Attraktionsphären der Zellen," Anat. Anz. VI. (1891).

‡ "Ueber Zelltheilung," Verhandl. d. Deutsch. Anat. Gesellsch. 1891.

neugefundenen Organe der Zelle, Sphäre und Centralkörper sich noch viel weitere Aufschlusse über das Zellenleben anknüpfen werden; und wenn man jetzt nahe am Ende dieses Jahrhunderts wagen will, ein wenig in das folgende hineinzuprophezieren, so dürfte sich sagen lassen dass wahrscheinlich um 1933, wenn nicht viel früher, die Entdeckung der Sphären und Centralkörper durch van Beneden in der Geschichte der Biologie einen ebenso denkwürdigen Platz, vielleicht einen wichtigeren einnehmen wird, als die Entdeckung des Zellkernes vom Jahre 1833."

A similar view of the importance of these structures is taken by Guignard* as a result of his study of their occurrence and history in the cells of plants. "Au total la partie fondamentale dans l'étude morphologique de la fécondation paraît resolue; le phénomène n'est pas, comme on avait cru pouvoir admettre jusqu'ici de nature purement nucléaire; il ne consiste pas simplement dans l'union de deux noyaux d'origine sexuelle différente, mais aussi dans la fusion de deux corps protoplasmatiques dont les éléments essentiels sont les sphères directrices de la cellule mâle et la cellule femelle." †

This generally accepted view of the importance of the centrosomes has been recently opposed by Bürger. (‡) He expounds and defends the view that the centrosomes and attraction-spheres are not organs of the cell, but are structures of no special significance, the appearance of which is due to the attraction exerted on one another by the microsomata or granules of the protoplasm. These would, he holds, be drawn in towards a centre by the supposed attractive force, but would become so closely crowded at a certain point that their further passage towards the centre would be prevented, and we should have a clear central space without microsomata surrounded by a compact zone of these bodies. The fact that the centrosomes are stained more darkly

* "Sur l'existence des 'sphères attractives' dans les cellules végétales." C.R., T. 112.

† Annales des sciences naturelles, Botanique, 1891.

‡ "Was sind die Attraktionsphäre und ihre Centralkörper?" Anat. Anzeiger, VII. (1892).

than the ordinary substance of the cell he explains by the supposition that, by the pressure exerted by the zone of microsomes attracted towards the centre, the protoplasm of this central part is in a more condensed condition than in other parts of the cell.

Some objections to this view of the matter have been well expressed by Fick.* It seems assailable on many grounds. In the first place, it assumes the operation of a force for the existence of which there is no evidence. This attraction between the microsomes is not a molecular force—the microsomes being bodies of (comparatively speaking) large size. What then is it? But, even if we admit the operation of this force, it seems to me very unlikely that it would act in the manner supposed. The effect of such an attraction would inevitably be the formation of groups having a compact central part. If the arrangement round a central space occurred it would be an unstable condition, and very readily disturbed. In such a hollow sphere of microsomata, kept in equilibrium by mutual pressure, moreover, there would not, it appears to me, be any pressure exerted on the protoplasm of the central space sufficient to increase its density.

But the strongest evidence against this ingenious theory is afforded by the observations that have been made, in the case of cells of many different kinds, on the history of these bodies, and their evident relations to the process of nuclear division. For why should mere hollow spheres of granules of no functional importance within the cell, but drawn together by some unknown form of force, divide as the centrosomes are seen to do with perfect regularity at a certain stage in the process of division of the cell?

There is then good reason for the view that the centrosomes and attraction-spheres, with the spindle fibres that proceed from them, are of importance in the phenomenon of cell-division; and according to Rabl and other recent writers they form the actual vital centres of the cell.

* "Bemerkungen zu O. Bürger's Erklärungsversuch der Attraktionssphären." Anat. Anz. VII. (1892).

The significance of these bodies in the phenomena of impregnation has been universally recognised since the publication of Fol's* brilliant observations, and Guignard's more recent discoveries have proved that they play a precisely analogous part in the fertilisation of flowering plants.† They have been found to occur in the ova of a variety of animals from the earliest stages of their development, and they have also been detected in the male sexual cells, and recently in the spermatozoa themselves. Thus the view that, as the spermatozoon is little more than a nucleus, the nucleus must be all-important in reproduction and inheritance has been gradually losing ground; with the entry of the spermatozoon there appears within the ovum not only the male pronucleus, but also a male centrosome which is in all probability derived from the cytoplasmic part of the spermatozoon; and this would appear to take part equally with the male pronucleus in bringing about fertilisation. Guignard's general conclusion from his observation of the behaviour of these bodies in the fertilisation of plants is that fecundation consists "not only in the copulation of two nuclei of different sexual origin, but also in the fusion of two protoplasms likewise of different origin represented essentially by the attraction-spheres of the male and female cells."

On the other hand a good many observations and experiments on the Protozoa seem to point to the importance of the nucleus in that group in connection with the regeneration of lost parts. But here we meet with apparent contradictions, for while Balbiani‡ states that regeneration takes place in *Stentor* only in the case of portions that contain a part of the nucleus, Gruber§ finds that when spontaneous fission has been once initiated, if a transverse section be made so that none of the nucleus remains in the

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* "Die 'Centrenquadrille,' eine neue Episode aus der Befruchtungsgeschichte." Anat. Anz. VI. (1891).

† "Sur la nature morphologique du phénomène de la fécondation." Comptes Rendus, T. 112, p. 1320.

‡ Annales de Micrographie, iv. (1892). Abstract in the Journal of the Royal Micros. Soc. Dec. 1892.

§ "Ueber künstliche Theilung bei Infusorien." Biol. Centralbl iv. and v.

anterior portion, the latter, though devoid of nuclear substance, will form a complete animal. If we accept both of these sets of observations as correct they lead to the important result that, while under normal circumstances regeneration does not take place in the absence of a nucleus, yet, when spontaneous fission is about to take place, something of unknown nature is formed or separated which, though not a nucleus, is capable after artificial fission of giving rise to a new nucleus in the non-nucleated part. This observation of Gruber's in fact throws a serious difficulty in the way of the unreserved acceptance of the general principle laid down by him in the earlier of the two papers referred to :—"Zellplasma kann anscheinend immer nur seinesgleichen, nie aber Kernplasma hervorbringen ; das letztere ist mit anderen Worten kein Umwandlungsprodukt des erstern, und damit müsste auch die Möglichkeit freier Kernbildung ausgeschlossen sein." For here appears to be a case in which nuclear substance *is* formed from cell-protoplasm.

So far as recorded observations go it is the chromatin substance, not of the nucleus itself, but of the relatively insignificant *para-nucleus*, that is of importance in the conjugation of the Infusoria, and it has not been shown that any centrosomes take part in the process. But little of importance seems to have been added to our knowledge of this part of the subject since the date of Maupas' remarkable observations.

During the maturation of the ovum and the genesis of the sperm-cell it was observed some years ago in the case of *Ascaris* by Hertwig*, and more recently in the case of a hemipterous insect by Henking†, that there is a reduction of the number of chromosomes by a half. Though it is difficult to decide in the present state of our knowledge what deductions to draw from this remarkable fact, the investigations of Guignard, leading to the result that a precisely corresponding reduction takes place in the case of plants, seem to prove that it has a deep morphological or physiological significance.

* Arch. f. Mikro. Anat. 1890.
† Zeitschr. f. wiss. Zool. 1891.

Some difference of opinion still exists with regard to the derivation of the spindle—whether it is formed from the achromatin network of the nucleus or from matter which passes in from the extra-nuclear cytoplasm; but the preponderance of evidence and of authority would appear to be in favour of the latter view—at least as regards the greater part of the spindle.

Some cases which have been observed in the Protozoa seem at first sight to point in an opposite direction; in these instances the nuclear membrane does not disappear on division, and the spindle fibres appear within it; but there is nothing to show that these spindle fibres, growing out from the centrosomes, do not perforate the nuclear membrane and thus reach the interior of the nucleus.

These complicated changes in the chromosomes, centrosomes, and attraction-spheres that accompany cell-division are, as is well known, not always observable when a cell divides. Besides the complex mitotic cell-division, we find in many instances a simple or *amitotic* form, in which the nucleus simply becomes constricted into two parts, which separate from one another as the cell divides. Now, as this amitotic form of nuclear division is found to be constant in certain kinds of cells under certain conditions, the question naturally arises—To what is this due? Why should one set of cells divide constantly in one way and others in another? What special purpose is served by the more complex kind of division, and what are the conditions which render it unnecessary? Various attempts to answer this question have been made in the course of the past year.

Flemming regards as admissible the conception that only the mitotic form of nuclear division leads to physiological increase and regeneration of cells, while the amitotic fragmentation of the nucleus, with or without the division of the cells, represents either a degeneration or an aberration, or perhaps in many cases aids in the cellular metabolism by increase in the periphery of the nucleus.

Ziegler* expresses somewhat similar views. To these he was led first by the study of the periblast of bony fishes, in which

* "Die biologische Bedeutung der amitotischen (direkten) Kerntheilung im Thierreich." Biol. Centralbl. 1891.

during segmentation the nuclei divide with caryokinesis, while later, when the cells have definitely assumed the function of taking up the nutrient matter of the yolk, division is always direct.

In general Ziegler concludes that fragmentation (which term he uses as the equivalent of direct nuclear division), takes place in the case of cells which do not divide any more, or in protoplasm-masses which have been produced by imperfect cell-division. Its appearance is dependent on the fact that the cell is becoming specialised—adapted to a particular function. The nuclei are degenerate inasmuch as the cell is capable of no further division, and, as a result, cannot take part morphologically in the further building up of the embryo, or in the phenomena of re-generation. The appearance of amitotic nuclear division, according to Ziegler, always indicates the end of the series of divisions. It is very unlikely that nuclei which once come to divide amitotically will ever again divide with mitosis. As a rule, he holds, the amitotin nuclear division is not followed by cell-division.

The nuclei which divide amitotically are always characterised by their specially large size, and in cells with such meganuclei there always goes on a particularly active process of secretion or assimilation.

Ziegler adduces a number of cases of amitotic cell-division in both vertebrates and invertebrates which, he maintains, tend to bear out his view.

Löwit* dissents altogether from Ziegler's view that direct division of nuclei indicates the termination of the series of divisions, and states that in the blood-cells of the crayfish and the leucocyte elements of the rabbit's lymph he has observed amitotic cell-division leading to a true new formation of cells. He distinguishes between a process of *fragmentation* which is degenerative, and a process of direct nuclear division which is not.

* "Ueber amitotische Kerntheilung." Biol. Centralbl. 1891.

Verson* and Frenzel† also adduce particular cases of direct nuclear division which, as they maintain, are incapable of being explained in accordance with Ziegler's view.

Bütschli‡ has reiterated and reinforced in the course of the last year the arguments in favour of his view of the nature of protoplasm. By his experiments with certain "emulsions," first described by him several years ago, he claimed to have effected something towards elucidating the real nature of living protoplasm, and also towards explaining as purely physical and chemical some of the phenomena characteristic of living protoplasm, and commonly set down as manifestations of purely vital forces.

Bütschli's method of experimenting is now well known. With thickened olive oil is mixed finely powdered carbonate of potash. When a drop of this mixture is placed on a slide and covered with a cover-glass, under which water is run, it exhibits, when examined under the microscope, remarkable streaming movements resulting in change of shape and of position, so that it bears some resemblance to a gigantic living *Amœba*. The drop has a vesicular or frothy character owing to its consisting of numerous minute vesicles containing soapy substance separated by thin layers of oil.

We have here a very complex system of contending surface tensions, a system in which very slight influences acting from the outside, such as currents in the surrounding water, may alter the balance of the whole ; some of the superficial vesicles burst ; this disturbs the balance of the tensions in the neighbouring parts, and the disturbance passes through the drop, with the result that a streaming movement is brought about, and a resulting change of shape.

It is contended that the movements of living protoplasm are in some cases so like those of this artificial representative that the former is probably similar as regards its general physical condition

* Biol. Centralbl. 1891, p. 556.

† "Zur Bedeutung der amitotischen (direkten) Kerntheilung." Biol. Centralbl. 1891.

‡ "Untersuchungen über mikroskopische Schäume und das Protoplasma."

to the latter. The structure of protoplasm is vesicular or frothy, and its movements are due to purely mechanical forces similar to those that operate in bringing about the movements in our drop of frothy emulsion.

That the probability of this is established as regards some forms of protoplasm and some protoplasmic movements can hardly be doubted. But there is danger lest we imagine that this conclusion carries more with it than it really does. It is important to know that some of the movements of protoplasm can be explained in this way; but in accepting this explanation we must guard against the idea that we are thereby making an important step in the direction of destroying the conception of vitality as distinguished from a peculiarly subtle and complex combination of chemical and physical forces. The only conclusion that the vitalist will admit to be capable of being legitimately drawn from such experiments is that some of the movements of living protoplasm may not be vital.

That protoplasm is in many cases of a vesicular, alveolar, or, as Prof. Bütschli prefers to call it, foamy, nature will be granted readily enough by all who have given attention to the subject. But that all that we observe of structure in the cell—whether of the lowest organisms or of the highest—is brought about merely by this vesicular arrangement, is not to be so readily conceded. When we come to take special cases and to attempt to interpret them in accordance with this theory, we soon come to meet with many difficulties. That some part of what we often take for reticulate and fibrous structure may really be due to the vesicular nature of the protoplasm is probable enough; it may also be conceded that some of the striations observable in the cell may have resulted from regular streaming movements of the protoplasm leaving rows of vesicles; but a wide difference exists between admitting this and subscribing to the view that all cytoplasmic structure is capable of this explanation.

For in examining specialised cells of a size to render their study favourable for the interpretation of minute structure, we find appearances which, as it seems to me, are not capable of being interpreted in the manner proposed: appearances which, being constant for the same cell under varying methods of treatment, cannot be produced by the action of re-agents.* If such a cell is watched while some fixing agent of a favourable character is applied to it, the new features which come out appear, not like something brought about by precipitation or streaming of vesicles, in which case some trace of the movements would surely be capable of detection, but very much in the same way as the features of a landscape come gradually into view at dawn. No part of the structure seems to be manufactured before our eyes; it merely gradually emerges into view. Thus we get regularly arranged systems of lines which, if they are not networks of fibrils, are certainly very unlike division-walls between series of vesicles, and arrangements of definite granules which are equally impossible of interpretation in accordance with Bütschli's theory. We find, moreover, in the cytoplasm certain bodies of a definite nature which are observed to go through certain well-defined series of changes, some of which entail movements of a restricted and definite character. How are we to explain the phenomena of karyokinesis in the absence of any fibrils or other guiding and contracting elements within the cell?

This view of the matter has been forcibly put by Flemming:—"Ich befinde mich in Einklang mit Kupffer in der Meinung dass wir in der That guten Grund haben hier wirkliche wenn auch natürlich nicht starre sondern vital veränderliche Bauverhältnisse anzunehmen, nicht aber, wie andere meinen, eine emulsionartige Masse, in der Strömungen und Körnchenaufreihungen kommen und schwinden."†

Moreover the definiteness of form observable in most unicellular animals, and most cells of multicellular, seems to require some other internal structure than mere vesicles. In the absence in many cases of an external stiff enclosing layer, how are we to

* Apathy in a paper "Ueber die Schaumstruktur hauptsächlich bei Muskel- und Nervenfasern" (Biol. Centralbl. 11, 1891) denies that such alveolar or frothy structure exists in nerve or muscle fibres.

† "Ueber Zelltheilung," Verhandl. der deutsch. Anat. Gesellsch. 1891.

account for a return to a certain shape after the undergoing of active or passive changes of form?

When the vesicular theory of cell-structure is applied to the nucleus it meets with still greater difficulties. Flemming* has lately protested against the view that the appearances in nuclei described by himself and others are due to post-mortem changes. In the living condition, in very many cases the nucleus appears quite clear and devoid of structure, except that perhaps a nucleolus may be distinguishable. The internal structure only becomes visible gradually if no re-agents are employed, more suddenly under the action of acetic acid. The structure becomes visible only post-mortem, but is not to be regarded on that account as artificial. Under the action of acetic acid the granules and threads start into view in a manner which proves that they cannot be formed by movement and re-arrangement of the nuclear substance. And in some nuclei these structures are visible in the living condition of the cell without the use of re-agents.

But the difficulties in the way of accepting Bütschli's conclusions as sufficient become most manifest when we consider the case of the ovum. It is difficult to be satisfied with a view of cell-structure which would lead to the conclusion that the difference between the ovum of an Echinoderm and that of a Mammal is merely a difference in the chemical composition of the protoplasm, and, structurally, in the size and disposition of the bubbles or vesicles. To account for the differences in the developmental history we need something, call it what you may—physiological molecule, micella, idioblast—between the chemical molecule and the vesicle, something the special properties of which determine the direction of the development.

Altmann† has recently published a short paper which may be regarded as a supplement to his work "Die Elementärorganismen und ihre Beziehungen zu den Zellen," issued two years ago. He

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* "Ueber Unsichtbarkeit lebendiger Kernstrukturen." Anat. Anzeiger, 1892.

† "Ein Beitrag zur Granulalehre." Verhandl. Anat. Gesellsch. 1892, pp. 220-223.

here gives an account of a method specially adapted for bringing out distinctly the intergranular network of the nucleus. As a result of the employment of this method of preparation he claims to have demonstrated that the coarser trabecular networks of various authors exist only as local thickenings of this intergranular network; the wide spaces between the trabeculæ, however, do not exist, but are taken up by granules and the fine intergranular network of the nucleus. This intergranular network of the resting nucleus shows the same colour-reaction as the so-called chromatin substance of the dividing nucleus.

Similar networks are, as is well known, common in the cytoplasm, and these, as Altmann has already shown, are composed of rows of fine granules. The larger granules in the meshes are derived from the small granules of the network. Altmann reiterates his view that the really fundamental structures in the cell are the granules and not the network. Probably the network in the resting nucleus is not capable of being distinctly analysed into rows of granules only because of the excessive smallness of the latter; the changes which the network undergoes in cell-division seem to indicate the probability of such an analysis.

Recent work on Marsupials and Monotremes.

At the beginning of last year Cope* published a paper in which he expressed doubts of the Marsupial nature of Stirling's *Notoryctes typhlops*, and suggested certain affinities with *Chrysochloris*, the Golden Mole, an Insectivore.

He pointed out that mammae had not been detected in the pouch, and drew the inference that the early parturition of the Marsupials does not hold good in *Notoryctes.* The two osseous nodules in the tendon of the external oblique muscles, he maintains, resemble the fibro-cartilage found in a corresponding position in some dogs rather than true marsupial bones. The inflection of the angle of the mandible is not greater, he points out, than that

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* "On the habits and affinities of the new Australian Mammal, *Notoryctes typhlops.*" American Naturalist, February, 1892.

seen in some Glires and Insectivora. The form of the skull seems to indicate a brain like that of Chrysochloris, and with apparently larger cerebral hemispheres than is usual in the Marsupials.

Among other characteristics in which Notoryctes approaches the Insectivora and differs from the Marsupials he refers to the imperforate palate, the presence of a patella, and the arrangement and number of the incisor teeth, which are neither diprotodont nor polyprotodont, but resemble those of ordinary mammals in being three on each side both above and below.

He then points out what he regards as special resemblances to the Chrysochloridae, and adds:—"Such an aggregate of resemblances to the *Chrysochloridae* signifies, it appears to me, zoological affinity. Whether *Notoryctes* will ultimately be found to enter the Marsupialia or not, it must be a descendant out of the same stock as that which gave origin to the *Chrysochloridae*. But I suspect the brain, female generative organs, and foetal characteristics will turn out to resemble those of *Chrysochloris*, as do its other characters, and in that case *Notoryctes* will enter the *Insectivora*."

In the preceding October Stirling had read an additional paper on *Notoryctes*,* in which two small mammae with "exceedingly minute nipple-like projections" are described as situated in the pouch. The vagina also appears to have a median septum; but the account given of the female generative organs is, owing to the condition of the specimen, by no means entirely satisfactory, and more remains to be done in this direction.

Gadow† has also published the results at which he has arrived by an examination of *Notoryctes*, especially as regards the skeleton and the teeth; and, as was to be expected, pronounces unequivocally for its marsupial affinities. He expresses the opinion, however, that if we had only the skeleton without the teeth, and if it had been found in America, there would have been strong reasons for

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* "Further notes on the habits and anatomy of Notoryctes typhlops." Trans. Roy. Soc. of South Australia, 1891, pp. 283-291, pl. xii.

† "On the systematic position of *Notoryctes typhlops*." Proc. Zool. Soc. 1892, p. 361.

putting *Notoryctes* down as an Edentate. He gives the following as the complete dental formula :—i. $\frac{3}{3}$, c. $\frac{1}{1}$, pm. $\frac{2}{2}$, m. $\frac{4}{4}=\frac{10}{10}$.

As a result of comparison with the various families of Marsupials he arrives at the conclusion that the Notoryctidae are a family of Polyprotodont Marsupials more nearly related to the *Dasyuridae* than to the *Peramelidae.*

In Owen's memoir "On the structure of the Brain in Marsupial Animals," published in 1837, he states that the marsupial brain is devoid of the corpus callosum or great commissural band between the two cerebral hemispheres so highly developed in the placental mammals. The study of the brains of the Platypus and Echidna by Eydoux and Laurent, and later by Owen, led to a similar result with regard to the Monotremes. These statements were uncontroverted, and accordingly became incorporated in all the text-books of comparative anatomy, until in 1865, Flower published a paper in which he maintained that a true corpus callosum is present in the Marsupials and the Monotremes, though in a rudimentary form. Last year Johnson Symington read a paper on this subject before Section D of the British Association* in which he shows that what was regarded by Flower as representing the corpus callosum in the brains of Marsupials and Monotremes, is, as shown by the distribution of its fibres, in reality a commissure connecting the hippocampi majores and gyri dentati. So that, as Flower† has himself acknowledged the correctness of this view, we come back to Owen's original opinion that a corpus callosum does not exist as such either in the Marsupials or the Monotremes.

Sir William Turner‡ has investigated the external anatomy of the brain of *Ornithorhynchus.* A comparison with that of *Echidna* shows that the latter possesses a higher organisation; its bulk, as is well known, is much greater, its cerebral convolutions more

* "The Cerebral Commissures in the Marsupialia and Monotremata." Journal of Anat. and Phys. Vol. XXVII. (1892).

† Report of a meeting held in connection with a proposed memorial to Sir Richard Owen. "Nature," 1892.

‡ Journal of Anatomy and Physiology, XXVI. (1892).

numerous and complicated ; its olfactory region is larger ; and its cerebellum is both larger and more minutely divided by fissures.

Symington has investigated the organ of Jacobson in *Ornithorhynchus** and in the kangaroo and rock-wallaby,† the result being, briefly, that, whereas in the two latter there is not any wide difference from what is observable in the Eutheria, in the former, as in *Echidna*, the organ is very extensively developed, running further forward than in the *Eutheria*, and with a complete tube of cartilage from which a well-developed turbinated process passes inwards.

Kükenthal's‡ researches on the dentition of *Didelphys* are of great interest and importance, as his general results are most probably applicable to all Marsupials, and have, moreover, an important bearing on the question of the evolutional history of the Mammalia. Kükenthal finds that in the Marsupial, as in Mammals in general, there are two rows of tooth-rudiments, an inner and an outer, developed from the primitive dental fold. In the higher Mammalia the inner set give rise to the permanent, the outer to the milk dentition. In the Marsupial one tooth alone—the last premolar—is developed from the former of these sets of rudiments, while all the remaining teeth are formed from the latter. Hence the conclusion follows that all the teeth of Marsupials, with the exception of the last premolar, are the equivalents of the milk dentition of the higher Mammals.

Thomas§ admits the justness of this deduction, but points out that if the Marsupials are, as Kükenthal supposes, primitively diphyodont, and have become almost completely monophyodont by a process of suppression of the teeth of the set corresponding to the permanent series of the higher Mammalia, it becomes somewhat difficult to explain the case of *Triconodon*, one of the earliest of known Mammals, in which there is only one tooth with a

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* Proceedings Zoological Society, 1892.

† Journal of Anatomy and Physiology, XXVI. (1892).

‡ Anatomischer Anzeiger, 1891; Annals and Magazine of Natural History, 1892.

§ Annals and Magazine of Natural History, 1892.

vertical successor, and that the very tooth which has a vertical successor in the case of the Marsupials of the present day.

Röse* gives an account of the results of a study of the development of the teeth in the Marsupials, in which he states that, as regards the general mode of development, there is little difference between that group and other Mammals. He finds that, as is generally accepted, it is for the most part only the last premolar that is formed from the accessory ridge; that is to say, that tooth alone belongs to what corresponds to the permanent set of other Mammals; but the same in all probability holds good of the last incisors of *Perameles* as well as *Macropus* and *Phalangista.* This last premolar either simply pushes itself into a gap in the first row of teeth—none of the latter becoming absorbed (as in *Didelphys, Phalangista Cookii, Perameles Doreyanus, Betideus bidens, Myrmecobius*), or takes the place of the last premolar of the first set which becomes absorbed (*Phalangista* sp., *Macropus lugens, M. giganteus, Phascogale penicillata* and the fossil *Triacanthodon serrula*).

With the exception of the last premolar, and perhaps the last incisors, the permanent teeth of the Marsupials seem, as previously pointed out by Kükenthal, to be the equivalents not of the permanent teeth of other Mammals but of the milk or deciduous set.

Throughout the Vertebrate series, he points out, from the Selachii to the Mammalia, there is a tendency to the evolution of the dentary system taking the direction of a reduction in the number of rows and series and an advance in the specialisation of the individual tooth. The Marsupials, in which the second dentition has been reduced almost to a vanishing point, thus appear to have advanced beyond the placental Mammals on the former of these lines of tooth evolution; but this can hardly be regarded as a higher development, since the loss of the second dentition can only be looked upon as an advance when the teeth of the single series grow throughout life from persistent pulps—a condition

* "Ueber die Zähnenentwickelung der Beutelthiere." 'Anat. Anzeiger, 1892.'

which occurs in the Marsupials only in the case of the Wombats.

There seems to be little doubt that the ancestors of both the placental Mammals and the Marsupials were Diphyodont, possessing two series of teeth, and that the Marsupials have attained to a practically monophyodont condition by the almost complete suppression in all of them of the teeth of the second set; while among the higher Mammals such a suppression, which, as Kükenthal maintains, is never complete, is to be observed only in certain exceptional groups.

On the motion of Mr. Brazier a cordial vote of thanks was accorded to the President for his interesting Address.

In the unavoidable absence of the Hon. Treasurer the President read the financial statement, which showed that on December 31st last there was a credit balance in the Bank of £175 10s. 2d. in addition to the sum of £41 19s. held on account of the Macleay Memorial Volume. The Treasurer also reported a considerable amount due to the Society arising out of subscriptions in arrear.

On the motion of Mr. Maiden it was unanimously resolved :—"That the Members of the Society, having heard with sincere regret of the death of the Rev. Dr. Woolls, desire to record their warm appreciation of his enthusiastic and untiring efforts to promote and popularise the study of Australian botany; and that the sympathy of this Meeting be respectfully tendered to Mrs. Woolls."

On the motion of Mr. Garland it was unanimously resolved :—"That this Meeting desires to record its approval of the arrangements, financial and otherwise, made by the Council for carrying out the recommendations of the last Annual Meeting respecting the Macleay Memorial Volume."